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A multiscale simulation technique for moderate-Kn flows DAVID KESSLER, ELAINE ORAN, CAROLYN KAPLAN, Naval Research Laboratory — Gas flows for transition-regime Kundsen numbers (ratio of molecular mean-free-path to system size) and low fluid velocities occur in microscale devices operating at normal densities and pressures. Such flows are particularly difficult to simulate because there is no general and robust method that both applies and gives adequate answers in any reasonable computational time. Navier-Stokes methods (NS) are not accurate enough and particle based methods such as Direct Simulation Monte Carlo (DSMC) suffer from excessive noise in the solution. We are developing a multiscale simulation technique that combines use of NS and DSMC by replacing the constituitive relations in NS are by a viscous stress tensor and a heat flux vector obtained directly from independent, short-duration DSMC simulations. The approach is illustrated by computing a one-dimensional, planar Couette flow at moderate Knudsen numbers. We discuss computational issues encountered, such as data exchange between the continuum and molecular levels, statistical noise reduction, and the application of wall boundary conditions in the continuum-level solver. Problems associated with computing multidimensional flows are briefly discussed.

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